Remarks

By this Amendment, claims 1-23 are pending, claims 24-41 are canceled and new claims 42-45 are added. Reconsideration is respectfully requested.

Rejection of Claims 1-41 under § 102(b) or § 103(a) in view of Yang

Claims 1-41 are rejected under § 102(b) or § 103(a) in view of Yang et al., Chinese Ag. Chem. Society, (1998) 36(6), 555-564. Applicants traverse.

Claim 1

Claim 1 has been amended to recite a method of making a glucosamine composition comprising providing a source of chitin-containing fungal biomass having cells with cell walls having proteins, lipids and/or polysaccharides therein. Pretreating the chitin-containing fungal biomass with a first acidic solution at a concentration of from about 0.05 to about 20% acid to break down the cell walls of the fungal biomass and release at least a portion of proteins, lipids and/or polysaccharides therein, without converting a substantial significant amount of chitin to glucosamine. And converting the chitin in the remaining solid fungal biomass to glucosamine to form the glucosamine composition.

The Yang reference discloses a first acid treatment at a much higher concentration than is recited in amended claim 1.

The Yang reference first step (that the Examiner equates to the claim 1 pretreatment step) is performed at a very high concentration of acid, 10 N HCL. (See Yang, para. 3 – stating the sample was mixed with "10 mL of 10 N HCl solution and reacted at 20°C for 16 hours." Also see, Yang at "Results and Discussions – Measurement of Glucosamine" para. 1.) Applicant's claimed acid range is 0.05 to about 20% while **Yang's acid concentration is greater than 28% (10 N HCl)**. Specifically:

10 N = 10 equivalents HCl / L
HCl has 36.5 grams / equivalent
So 10 N HCL = 365 g/L HCl (I.e., 10 · 36.5 g/equiv. = 365 g HCl/L)
So, 10 ml of 10 N HCl contains 3.65 g HCl
Density of 10 N HCl = ~ 1.16 g/mL, so the
Yang first step contains 1 g (sample) + 11.6 g of 10 N HCl
if the density of HCl is about 1.16 g/ml then 10 N HCl is about 31.5%
and with the sample added the acid concentration is about 29.0%

Accordingly, the acid range recited in the pretreatment step in amended claim 1 (0.05 % to 20%) is significantly lower than the Yang reference 29% HCl in its disclosed first step. The acid concentration in the presently recited claim is kept at a lower concentration in part to avoid converting a significant amount of chitin to glucosamine during the pretreatment step.

Please also note the § 1.132 Declaration filed herewith. To the extent that the Examiner asserts that these differences in acid concentration are allegedly obvious as being within the knowledge of a person of ordinary skill in the art to try such ranges, Applicants disagree.

The presently claimed method reaction parameters were not in any manner predictable. As stated in the § 1.132 Declaration filed herewith, changing temperatures, acids, acid concentrations, reaction times and other reaction parameters to produce a glucosamine composition from fungal biomass does not and did not provide predictable results. Instead, it took multiple chemists and laboratory technicians over a year performing, analyzing, and studying hundreds of test procedures to develop the claimed method.

It is notable that fungal biomass chitin to glucosamine conversion processes are highly complex in part due to the multiple chemistries in the processes, which chemistries and reactions cannot be simply separated apart from one another and analyzed independently because the chemistries are inter-related and inter-twined. Thus, the inventors spent between 18 and 24 months studying/testing the fundamentals of various processes to convert chitin in fungal biomass to glucosamine, to understand and manipulate the multiple chemistries in the reaction processes, the different rates to the side products, in order to develop the claimed processes.

Accordingly, such changes in process parameters cannot rightly be considered obvious (predictable) but instead require extensive study and testing. As a result, Yang, whether considered independently or combined with the alleged knowledge of a person of ordinary skill in the art, neither teaches nor suggests the claimed process; claim 1 is allowable over the art of record.

Claims 2, 6, 11, 12

Claims 2, 6, 11, 12 depending from claim 1 are allowable over Yang based on their unique and non-obvious combination of method steps and for the same reasons as set forth above in relation to claim 1.

Claim 3

Claim 3 recites that the solid fungal biomass is separated from at least a portion of the proteins, lipids and/or polysaccharides after the pretreating and prior to converting the chitin in the remaining solid fungal biomass to glucosamine. Yang discloses no such separation as its first acid treatment step and its second acid treatment step are both aimed at converting as much chitin to soluble forms of glucosamine as possible. See, for example, the language in para. 8 of Yang stating that the first step in the very concentrated HCl is performed for deacetylation of chitin and the second step with HCl is for depolymerization of chitin. There is no need or desire to separate the solid fungal biomass from proteins, lipids and/or polysaccharides in Yang. Accordingly, for this reason as well, claim 3 is allowable over Yang.

Claim 4

Claim 4 recites an even lower acid concentration than does claim 1 - from about 0.5 to 12%. The Yang reference teaches an acid concentration (29%) more than twice the highest value of the claimed acid concentration range. This highly concentrated HCl is utilized to convert chitin in the biomass to soluble forms of glucosamine (see Yang at "Results and Discussions – Measurement of Glucosamine" para. 1), *which conversion is explicitly and purposefully avoided in the pretreatment step as claimed by Applicants*. Accordingly, for this reason as well, claim 4 is allowable over Yang.

Claim 5

Claim 5 recites the method of claim 1 wherein the first acid step is performed at a temperature from about 60°C to about reflux temperature of a mixture of the fungal biomass and first acidic solution. The Yang reference discloses a first acid step at 20°C. Accordingly, for this reason as well, claim 5 is allowable over Yang.

Claim 7

Claim 7 recites the method of claim 1 wherein the second acid step - *converting the chitin to glucosamine* - comprises reacting the chitin with a second acidic solution having a concentration of from about 1 to about 2%.

Yang's second step (which the Examiner equates to certain of Applicants' claims conversion step) is performed at an acid concentration of 7.3% (2 N HCL). (See Yang at "Results and Discussions

– Measurement of Glucosamine" para. 1.) Applicants' acid concentration range recited in claim 7 is 0.05 to about 2%; thus, the Yang acid concentration is almost 4 times as concentrated as compared to the most concentrated level of the claimed second acid step.

Specifically:

2 N = 2 equivalents / L HCl
HCl has 36.5 grams / equivalent
So 2 N HCL = 73 g/L HCl (I.e., 2 · 36.5 g/equiv. = 73 g HCl/L)
or 7.3 g/ml
if the density of HCl is about 1.0032 g/ml then 2 N HCl is about 7.3 wt%

An advantage of having the pretreatment step (where chitin is not converted to glucosamine) as recited in claims 1 and 7 is that the step of converting chitin to glucosamine (the second acid step) can then be done with a much less concentrated acid. This reduces safety hazards for the process and reduces costs, as less concentrated acids are easier to treat and dispose, poses lower risks for workers and allows use of less expensive equipment for performing the process.

Because Yang discloses a second acid step with an acid nearly 4 times the concentration of the claimed acid concentration range, Yang does not teach or suggest the method of claim 7.

Claim 8

Claim 8 recites the method of claim 1 wherein the first acidic solution has an acid concentration of less than about 20% and wherein the fungal biomass and first acidic solution are mixed at a reaction temperature of less than about 100°C for a reaction period of less than about 4 hours.

As set forth above, the first acid step of Yang is nearly one and one-half times as concentrated (29%) as compared to the recited acid concentration (<20%). Yang's first acid step is performed in a process that is 4 times longer (16 hrs) than the claimed process time period (4 hrs). (See Yang, para. 3 – stating the sample was mixed with "10 mL of 10 N HCl solution and reacted at 20°C for 16 hours." Also see, Yang at "Results and Discussions – Measurement of Glucosamine" para. 1.) These differences in Yang from the claimed method are due to the fact that the Yang reference wants conversion of chitin to soluble forms in both the first and second acid steps, while the claimed method first acid step is a pretreatment step to remove impurities without converting a significant amount of chitin to soluble glucosamine.

Because Yang discloses a first acid step with an acid nearly one and one-half times as concentrated (29%) as compared to the recited acid concentration (<20%) and because the Yang treatments is conducted for a time period 4 times longer than the recited treatment time, Yang does not teach or suggest the method of claim 8.

Claim 9

Claim 9 recites the method of claim 1 wherein the fungal biomass is treated with an alkaline solution prior to breaking down of the cell walls with the first acidic solution.

Yang does not teach or suggest a treatment step with an alkaline solution at any time in the disclosed process. Thus, for the reasons set forth above in relation to claim 1 and for this reason as well, claim 9 is allowable over Yang.

Claim 10

Claim 10 recites the method of claim 1 wherein the fungal biomass is treated mechanically to break down the cell walls prior to the pretreatment with the first acidic solution.

Yang does not teach or suggest a mechanical treatment step at any time in the disclosed process. Thus, for the reasons set forth above in relation to claim 1 and for this reason as well, claim 10 is allowable over Yang.

Claim 13

Claim 13 is allowable for the reasons set forth above in relation to claims 1 and 4.

Claim 14

Claim 14 recites the method of claim 1, further comprising mixing the glucosamine composition with a dispersant and/or a binder to form a food supplement. Yang is directed to testing cereal grains for contamination with fungi.

Yang tests for the presence of small amounts of fungi contamination by testing the grains for the presence of chitin. (See, e.g., Yang, introduction paragraph, lines 1-9.) Chitin is detected by converting the chitin to glucosamine and conducting a colorimetric test to determine whether any glucosamine is present. Yang does not teach or suggest making a glucosamine composition nor does it teach or suggest making a glucosamine composition to combine with a dispersant and/or a binder to form a food supplement. Thus, for the reasons set forth above in relation to claim 1 and for this reason as well, claim 14 is allowable over Yang.

Claim 15

Claim 15 has been amended to recite a method of making a glucosamine composition from fungal biomass comprising in part pretreating the fungal biomass with an alkaline solution to break down cell walls of the fungal biomass and release proteins, lipids and/or polysaccharides therein, without converting a significant amount of chitin to glucosamine. Reacting the fungal biomass in an acidic solution with an acid concentration and at a reaction temperature and for a reaction period sufficient to convert chitin in the fungal biomass to glucosamine, and separating the glucosamine from the acidic solution.

Yang does not teach or suggest a treatment step with an alkaline solution at any time in the disclosed process. Further, Yang does not teach or suggest separating the glucosamine from the acidic solution. The Yang acid solution containing soluble glucosamine is instead diluted for testing for the presence of small amounts of glucosamine using a colorimetric method. Yang does not teach or suggest a separation step as Yang is not directed to producing a glucosamine composition per se. Thus, Yang does not teach or suggest the method of claim 15.

Claims 16-17

Claims 16-17 depending from claim 15 are allowable over Yang based on their unique and non-obvious combination of method steps and for the same reasons as set forth above in relation to claim 15.

Claim 18

Claim 18 recites the method of claim 15 wherein the alkaline solution comprises sodium hydroxide at a concentration of from about 1 to about 4%.

Yang does not teach or suggest use of an alkaline at any time during the Yang process. Thus, claim 18 is allowable over Yang

Claim 19

Claim 19 recites the method of claim 15, further comprising forming the glucosamine into a food supplement composition. For the reasons set forth above in relation to claims 15 and 14, claim 19 is allowable over Yang.

Claim 20

Claim 20 recites a method of obtaining glucosamine from fungal biomass by reacting the fungal biomass in an acidic solution with an acid concentration of 9% to 20% and at a reaction temperature of from about 90°C to about 160°C and for a reaction period sufficient to convert chitin in the fungal biomass to glucosamine. Claim 20 also recites the step if separating the glucosamine from the acidic solution.

Yang teaches two steps where both act to convert chitin to soluble forms of glucosamine – a first acid step using 29% HCl at 20°C (para. 3) and a second with 7.3% HCl at 121°C ("Results and Discussions – Measurement of Glucosamine" para. 1). Never does Yang teach or suggest a high acid concentration together with a high reaction temperature as recited in claim 20. Accordingly, claim 20 is not anticipated by Yang.

To the extent that the Examiner asserts that the reaction parameter differences between the claimed process and the Yang reference are allegedly obvious as being within the knowledge of a person of ordinary skill in the art to try such ranges, Applicants disagree.

As discussed above in relation to claim 1 and as set forth in the accompanying Declaration, the presently claimed method reaction parameters were not in any manner predictable. Changing process parameters in this complex chemistry area, such as changing temperatures and acid concentrations, when making a glucosamine composition from fungal biomass does not and did not provide predictable results. Instead, it took multiple chemists and months and months performing hundreds of tests and studies to develop the claimed method.

Accordingly, Yang, whether considered independently or combined with an alleged knowledge of a person of ordinary skill in the art, neither teaches nor suggests the claimed process and claim 20 is allowable over the art of record.

Claim 21

Claim 21 depending from claim 20 is allowable over Yang for the same reasons as set forth above in relation to claim 20.

Claim 22

Amended claim 22 recites the method of 20 wherein the reacting of fungal biomass in an acidic solution is performed in a sealed container that allows pressure therein to increase as a result of the reaction. Yang does not teach or suggest use of a sealed container for the reaction or an increased pressure. Rather than increase pressure to aid the conversion of chitin to glucosamine, Yang discloses use of two conversion acid reactions. Thus, for the reasons set forth above in relation to claim 20 and for these reasons as well, claim 22 is allowable over Yang.

Claim 23

Claim 23 recites the method of claim 20 wherein the reaction temperature is from about 105°C or greater and the reaction takes place at a pressure of about 2 atmospheres or greater. As discussed immediately above, Yang does not teach or suggest increasing the pressure to aid the conversion of chitin to glucosamine, but instead discloses use of two conversion acid reactions. Thus, for the reasons set forth above in relation to claim 20 and for these reasons as well, claim 23 is allowable over Yang.

Rejection of Claims 27, 28, 31 and 34-40 under § 102(a) or § 103(a) in view of Berry

Claims 27, 28, 31 and 34-40 are rejected under § 102(b) or § 103(a) in view of Berry et al., U.S. Patent No. 6,372,457. Claims 24-41 are cancelled herein to be pursued in a continuation application and thus this rejection is now moot.

New Claims

New claims 42-44 claim variations of the methods set forth in claims 1-23 and are allowable for the same reasons as set forth above in relation to those claims.

In addition, claim 42 recites in part, pretreating the biomass with an acidic solution at a temperature of from about 60°C to about reflux temperature of a mixture of the acidic solution and biomass to release the proteins, lipids and/or polysaccharides *without converting a significant amount* *of chitin to glucosamine*. Yang discloses a first step at 20°C (far below the claimed temperature) and the Yang second acid reaction step clearly converts chitin to glucosamine. Accordingly, for this reason as well, claim 42 is allowable over Yang.

Claim 43 recites in part, separating solids from the proteins, lipids and/or polysaccharides in liquid form and treating the separated solids to convert chitin therein to glucosamine. Yang does not separate the solids nor does Yang treat the solids that were separated to convert the chitin therein. Yang discloses no such separation as its first acid treatment step and its second acid treatment step are both aimed at converting as much chitin to soluble forms of glucosamine as possible. See, for example, the language in para. 8 of Yang stating that the first step in the very concentrated HCl is performed for deacetylation of chitin and the second step treatment with HCl is for depolymerization of chitin. There is no need or desire to separate the solid fungal biomass from proteins, lipids and/or polysaccharides in Yang. Accordingly, for these reasons as well, claim 43 is allowable over Yang.

Claim 44 recites the method of claim 20 wherein the converting of chitin in the fungal biomass to glucosamine is performed utilizing a single acidic solution step. As discussed above, the Yang process requires two acid steps to convert the chitin to glucosamine. Accordingly, for this reason as well, claim 44 is allowable over Yang.

Claim 45 recites a method of making a glucosamine composition comprising in part, pretreating a chitin-containing fungal biomass utilizing a first acidic solution to break down the cell walls of the fungal biomass and release proteins, lipids and/or polysaccharides therein, without converting a significant amount of chitin to glucosamine, converting the chitin in the pretreated fungal biomass utilizing a second acidic solution to glucosamine, and performing the converting step utilizing not more than about 6 g of the second acidic solution to produce 1 g glucosamine.

The Yang reference requires over 18 grams of HCl to produce 1 gram of glucosamine. This is shown by calculating the Yang acid hydrolysis as follows:

1.0 g fungal biomass = 0.2 g chitin (which theoretically equals 0.2 g glucosamine (GlcN))
Per the Yang procedure: 10 mL 10 N HCl = 3.65 g dry HCl + ~6.4 g water (6.4 mL water)
Acid concentration in Step 1 = ~36.4 wt%
Acid consumption = 3.65 g dry HCl / 0.2 g GlcN = **18.2 g dry HCl /1 g GlcN**

Accordingly, claim 45 is allowable over Yang.

Applicants' counsel requests the Examiner to please call her should there be any questions or need for further information.

Respectfully submitted,

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